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TWO-QUEEN COLONY MANAGEMENT FOR PRODUCTION OF HONEY[1/]

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Two-queen colony management (1, 2) represents an intensive system of honey production designed to obtain the maximum yield from each hive. During any short honey flow (about 2 weeks) one large colony will produce more honey than two or more smaller colonies having the same aggregate number of bees (3). In single-queen colonies the production per unit number of bees increases as the number in the colony increases up to the maximum (60,000 bees). This efficiency relationship remains high when populations are further increased through the use of a second queen. Because small colonies increase in population with time, their production efficiency over a long honey-flow period will rise. However, colonies with large populations throughout either a long or a short flow produce the greatest amount of honey, because their efficiency is high over the entire honey-flow period.

Strong colonies that are divided 5 to 7 weeks before the honey flow and then organized as two-queen colonies may yield twice the surplus honey produced by strong single-queen colonies. When such colonies are reunited, they usually have twice as much reserve pollen in the fall as single-queen colonies. These large pollen reserves are of great value in overwintering strong colonies. The performance of any healthy colony is based upon the capacity of the queen or queens to lay eggs, the population at the beginning of the active season, the available pollen supply, and the time and length of the honey flow.

1/ This paper brings up to date the information in E-693 issued by the former Bureau of Entomology and Plant Quarantine in May 1946.

2/ In cooperation with the University of Wisconsin Agricultural Experiment Station.

Hive Equipment

Under dry conditions such as exist in the Intermountain States, seven 10-frame standard hive bodies may provide adequate brood rearing and storage space for two-queen colonies if the honey is removed and extracted weekly during the main honey flow. In more humid regions eight to eleven bodies are required, because the nectar is thinner and more time is required to ripen the honey. Hives seven stories high can be worked satisfactorily, but few beekeepers care to operate taller hives even to obtain an increase in yield.

A shallow hive body for both brood chambers and supers has advantages when intensive management practices are applied to either single- or two-queen colonies. Early in the evolution of hive equipment, shallow brood chambers fell into disrepute because they were used to restrict brood rearing in order to force more honey into the supers. The resulting small colonies neither produced nor survived the winter as well as those in deeper hives. All these early hives were small by present standards, because multiple brood chambers are now used with all sizes of hive equipment. The size and shape of the hive units have little effect on production if enough are used for brood rearing, food reserves, and the storage of surplus honey. Success is determined by the skill of the operator in providing space at the right time and in the proper place to conform with the bees' normal behavior.

A hive that provides adequate storage capacity within a reasonable height is desirable for colonies that may yield 500 pounds of honey. Such yields are not uncommon for two-queen colonies. A hive body 20 inches square and 6 5/8 inches deep that holds 12 frames 6 1/4 inches deep meets these requirements without differing radically from other hive equipment. The 3/8-inch top bars of the standard shallow frames are too light for the maintenance of good brood combs. Most efficient management is possible when all hive bodies are uniform in size and therefore interchangeable.

Shallow super combs will be filled and sealed more rapidly than standard combs. This permits prompt removal of supers for extracting so that they may be returned for refilling, thus reducing the amount of equipment required to produce the crop. Shallow square hive bodies help to limit the height of the hive and reduce the gross weight of full supers. Beekeepers who have used them like them even though they must handle more units.

Shallow equipment has advantages not only for the productive season but also in the overwintering of large colonies. The space between brood chambers favors the movement of bees within the winter cluster. Eleven-frame modified Dadant shallow supers or even standard 10-frame shallow supers can be used, provided there are a sufficient number to give adequate hive capacity.

Shallow equipment is more expensive than deeper equipment, since more frames and hive bodies are needed for a given hive capacity. Cost is not proportional to size, because labor costs are greater than materials in the manufacture and assembly of beekeeping equipment. This disadvantage may be offset by gains from labor saved in management and higher yields from better colony control. Consideration of shallow equipment will generally apply to the purchase or construction of new equipment rather than to replacement of usable equipment of a less desirable type.

Organization of a Two-Queen Colony

Strong colonies should be used in establishing two-queen units. They should be divided when their condition and the available pollen supply will permit uninterrupted brood rearing. This will usually be 5 to 7 weeks before the main honey flow. It is better to delay 1 to 2 weeks in setting up the second brood nest until conditions are favorable than to make small divisions or to make them when pollen is not available.

The colony organization and important stages of the seasonal management for two-queen colonies for standard equipment are diagrammed in figure 1 and for the square type of shallow hive in figure 2.

Brood Nest Put Down (A).--Colonies that were wintered in hives with upper auger-hole entrances will have their brood nest in the upper chambers. From 2 to 3 weeks before they are divided they should be reorganized by interchanging the position of chambers 1-2-3-4 to position 4-3-2-1 and closing all auger-hole entrances. This manipulation stimulates more rapid brood expansion and allows the bees time to become accustomed to the bottom-board entrance. Excessive drifting away from the lower brood nest is thus prevented when the second brood nest is established on top.

Division of Colony (B).--A strong colony is divided temporarily into two units for the purpose of introducing the second queen. The bottom brood chamber should contain the queen, half the brood (mostly eggs and larvae), approximately 40 percent of the population, and reserve honey and pollen. Two supers of drawn comb are added above the excluder. The upper brood nest is placed above these supers, separated from them by an inner cover with the escape hole screened.

The upper brood chamber should contain three or more combs of mostly sealed and emerging brood, plenty of honey and pollen, and approximately 60 percent of the original population. Some of the bees will drift back to the lower entrance to give a fairly equal balance to the two brood nests. The more mature brood is placed in the upper unit,

because fewer bees will be required to protect the brood should there be a heavy drift back; also the emerging bees will strengthen the newly established brood nest and support the young queen. A 1-inch auger hole just below the front handhold provides an entrance for the upper colony. The young queen may be introduced by any of the customary methods. The rearing of a queen from queen cells in this part of the hive results in loss of valuable brood-rearing time.

If shallow equipment is used, a queen nucleus can be started on top of each colony 7 to 10 days earlier than the division would normally be made. This nucleus may be stocked with package bees or with bees from overwintered colonies. When the young queen is laying well, the nucleus can be strengthened by raising up a chamber containing principally sealed and emerging brood with plenty of young bees. The operator should spray both units with sugar sirup when uniting these bees to the nucleus. Spraying is done by directing a liberal amount of sirup down between the interspaces of the combs to wet all the bees. When laying queens are available in separate nuclei, the queen with her brood and bees may be united to the upper unit by the spray method when the colony is divided. Queen acceptance in either case is nearly 100 percent, and both queens continue egg laying without interruption.

The separate nuclei may be restocked to provide replacement queens. Queens that show up poorly in the nuclei should not be introduced to producing colonies. To insure a supply of good queens at all times, there is an advantage in maintaining from 10 to 20 percent as many nuclei with laying queens throughout the season as there are producing colonies.

Two-queen organization is established by removing the screened inner cover when the top queen has a rapidly expanding brood nest, usually 10 to 14 days after the division was made. The bees in both brood nests should be sprayed with sugar sirup when the two units are united. This is not always necessary, but it is recommended as a safety measure that can be applied easily. The upper queen may require additional brood combs at this time. All upper brood chambers should have auger-hole entrances.

Both the upper and lower brood nests must have reserve honey and pollen even after the screened inner cover is removed. Brood rearing may suffer or the bees may starve in one when there is plenty of food in the other.

Organization Early in the Flow (C).--This organization provides for unrestricted brood rearing and honey storage. It should be maintained just before and during the early part of the honey flow to insure maximum brood rearing, minimum swarming, and optimum storage. Since very little honey is stored in the lower brood nest, one standard brood chamber or two shallows provide plenty of space for a good queen. Supers between the lower and upper brood nests should never be allowed to become more

than half full. Too much honey here will cause the lower brood nest to become honey bound. If this occurs, the hive will operate as two separate colonies. When these supers become partially filled with honey, they should be raised above the upper brood nest and replaced by empty supers. The chambers used for the upper brood nest should be interchanged to place the heaviest chamber, which usually contains eggs and larvae, below those containing sealed and emerging brood.

Honey storage is most intense within and above the upper brood nest. The lower brood nest tends to supply bees to the upper one, and most of the colony's flight activity is through the auger holes of the upper brood chambers. Timely interchanging of these chambers permits the queen to expand her brood nest upward, where space is made available by emerging bees. It also stimulates the removal of honey surrounding the young brood put down, thus making more space available for the queen when the brood chambers are interchanged again. The movement of ripened honey from the brood nest hastens the finishing of the supers so that they can be extracted and returned for refilling.

During a good honey flow the colony must be manipulated every 6 to 8 days to maintain the optimum organization for both brood rearing and storage. Supers with empty combs from which the honey has been extracted are placed between the two brood nests. Those containing some honey are placed above the upper brood nest for finishing. During a heavy flow, especially when the nectar is thin, one or two additional supers may be needed above the upper brood nest to keep those separating the brood nests comparatively free of honey.

Reuniting to Single-Queen Status (D).--Colonies should be united back to single-queen status approximately 4 weeks before the expected end of the flow. It is seldom necessary to locate the queens. The upper queen usually survives, but if the lower one does, she is probably the better individual. With three deep or five shallow brood chambers at the disposal of the surviving queen, brood-chamber manipulations are seldom necessary for the remainder of the season. Supers that have been extracted should be placed on top of those containing honey. If the honey flow continues, these "wet" supers will be refilled without danger of restricting brood rearing by overcrowding the brood chambers with honey.

Super space should be provided generously. These double colonies may make daily gains of 20 to 30 pounds under flows that permit single-queen colonies to gain 8 to 12 pounds. Plenty of space is needed for the incoming nectar in addition to that required for storing honey. As soon as supers are finished, the combs should be extracted and returned for refilling.

When colonies are reunited to a single-queen status, they build up pollen reserves rapidly if pollen is available in the field. They have the population of two colonies and the brood of only one queen. During this period pollen and honey storage are both at the most efficient level for the number of bees in the colony.

Organization for Overwintering (E).--When the supers are removed at the close of the season, the colony should be organized for wintering. Colonies in the shallow equipment will winter as well in five bodies as in the four shown. They should contain 90 or more pounds of honey and as much pollen as possible. The hive should have a gross weight of at least 175 pounds in standard equipment and 200 to 225 pounds in the shallow. Colonies may not use all the reserve honey, but these large food reserves provide the best insurance that they will be ready for the next honey flow. Honey that is not consumed will add to the next year's crop by reducing the amount required to build up the reserve.

Mechanics of Manipulation

It is essential that the hive stands be level and situated on firm ground. The bottom boards should be close to the ground--not on raised hive stands. Two-queen colonies can be manipulated more easily if two men work together. Smoke should be applied to all entrances and under the metal cover as it is removed. The hive is then supported by a man on each side, who tip it over backwards to a horizontal position. The propolis will prevent the hive bodies from slipping, even when heavy hives are lowered.

As soon as the hive is horizontal, the supers above and below the upper brood nest should be quickly separated from contact with it, in order to prevent the queen from running into the supers. The queen excluder over the lower brood nest confines its queen. Smoke is used as needed when each hive segment is separated.

The bottom board is placed on the hive stand, and the hive is reassembled to conform with the required colony organization. The hive bodies are handled by grasping the top and bottom edges of the upper end rather than by the handholds. The condition of each brood chamber can usually be determined by a quick look at the combs from the bottom and by its weight. The upper brood chambers are interchanged on the basis of their weight and the stages of brood present--supers on the basis of their weight.

Working the hives in a horizontal position does not eliminate the necessity of lifting the hive bodies back into position. It does reduce the total labor and time required for the manipulations. This procedure also exposes less open equipment to stimulate robber bees. The upper

queen is less likely to run into the supers, and the bees are more gentle. The returning field bees are confused and offer little resistance. Those in the top hive bodies are not driven down into the lower part of the hive, where they would later be disturbed under a disorganized and congested condition.

Use of Queen Excluders and Foundation

A queen excluder over the lower brood nest is a necessity. Another queen excluder below the upper brood nest will prevent the upper queen from running down into the intervening supers when the colony is manipulated. Its use saves time in hive manipulation because the operator knows the location of the upper queen. A third excluder over the upper brood nest may be used to advantage under some conditions, but it tends to force more honey into the brood nest.

The upper queen can be maintained in her proper position without excluders by the timely rotation of the brood chambers. Most of the mature brood is placed above to provide space for the queen to expand her brood nest upward in accordance with her normal behavior.

Two-queen colonies can be handled most satisfactorily when drawn combs are available for both brood chambers and supers. During the main honey flow foundation can be drawn between the two brood nests. When the supers contain foundation, only the lower queen should be restricted with an excluder. When foundation is used above the upper brood nest, so much honey may be stored in the upper brood nest that empty combs must be substituted for those filled with honey in order to give the queen room.

Queen Supersedure, Replacements, Swarming, and Increase

The problem of supersedure is no greater in two-queen than in single-queen colonies except that, when one queen is poor and queen cells are started, cells usually will be built in the other brood nest.

When a new queen is introduced to either brood nest, the nests must be completely separated as when the original division was made. After all queen cells have been removed, a nucleus with a good laying queen may be united by the spray method. If there is a honey flow, the screened inner cover can be removed at the next manipulation without spraying the bees.

Swarming is not a problem when good queens are maintained in both brood nests and space for brood expansion and honey storage is provided by timely manipulations. Since the two-queen colony may have 25 to 30 pounds of bees, a great loss will result if the colony is allowed to swarm. The wings of both queens should be clipped. If the colony attempts to

swarm, both queens may be found in the lower brood nest. One of them may be returned to the upper brood nest when the conditions that caused swarming have been corrected. However, when the queens are shrunken, the drastic treatment of making a "shook-swarm" with one of the queens on a new set of combs is best. The other queen, with all the brood and adhering bees, can be set to one side to allow many of the bees to drift back to the original hive location. When both queens are laying normally, the hives can be recombined in a manner suitable to the honey flow (C or D).

Increase from two-queen colonies is not generally recommended, because the advantage of large pollen reserves for wintering strong colonies may be lost. If other single-queen colonies are storing large pollen reserves, the two-queen organization can be retained until the end of the honey flow. Such colonies may be wintered as double colonies by removing the lower queen excluder and placing at least 60 pounds of honey in dark combs above the lower brood nest. A moving screen or screened inner cover must be placed above this, and the upper brood nest set on top. The lower colony should be provided with a reduced bottom-board entrance and the upper colony with an auger-hole entrance in the top chamber. The auger holes in the intervening hive bodies should be closed.

In the spring a weak colony may be set above a good colony in the manner used to organize a two-queen colony by division, with an excluder beneath the weak colony in place of the inner cover. The bees of both colonies should be sprayed with sugar sirup when they are set together. If the weak colony has a good queen, some bees from the lower colony will move up and permit this queen to expand brood rearing. If it has a poor queen, nothing is lost as would be the case if brood or bees from a good colony were taken to strengthen a weak colony that has a poor queen.

Summary

Two-queen colony management is based upon the principle that honey production per unit number of bees increases as the population is increased. Not only do strong colonies produce more honey than less populous colonies, but they produce more efficiently. Colonies managed under the two-queen system overwinter with young queens, and the beekeeper focuses his attention on queen quality to a greater degree than under most systems of management. The larger pollen reserves accumulated after the colonies have been reduced to a single-queen status make it possible to overwinter stronger colonies for the next season.

Less equipment is used in producing a given crop of honey than is customary under single-queen management. However, there are some limitations to the use of standard hive equipment for two-queen colonies.

Close timing of manipulations is essential to meet the two-queen colony requirements, but this is equally important for the efficient management of any class of colony.

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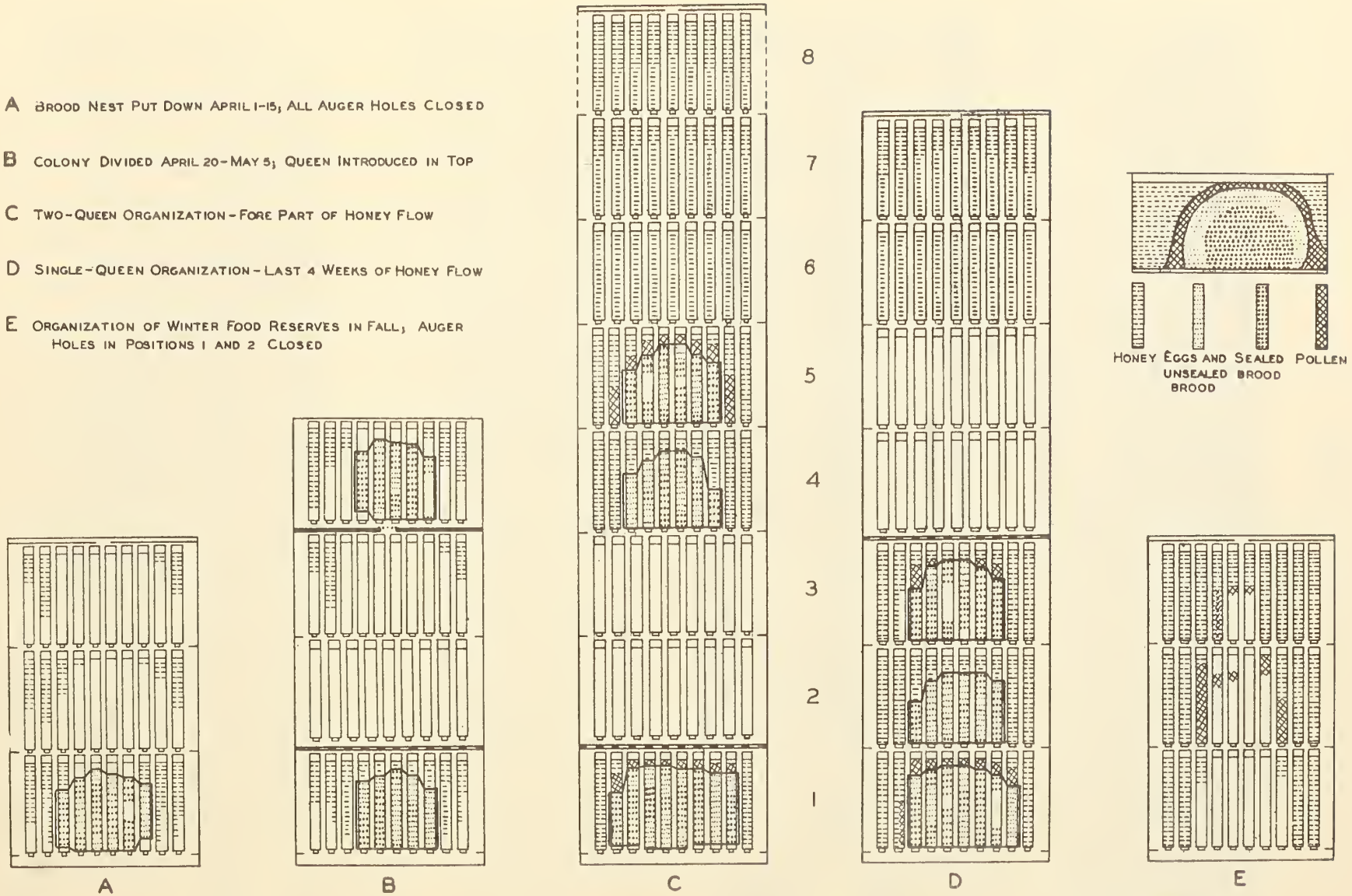

Figure 1.--Diagram of two-queen colony management with 10-frame standard equipment, showing the organization after manipulation.

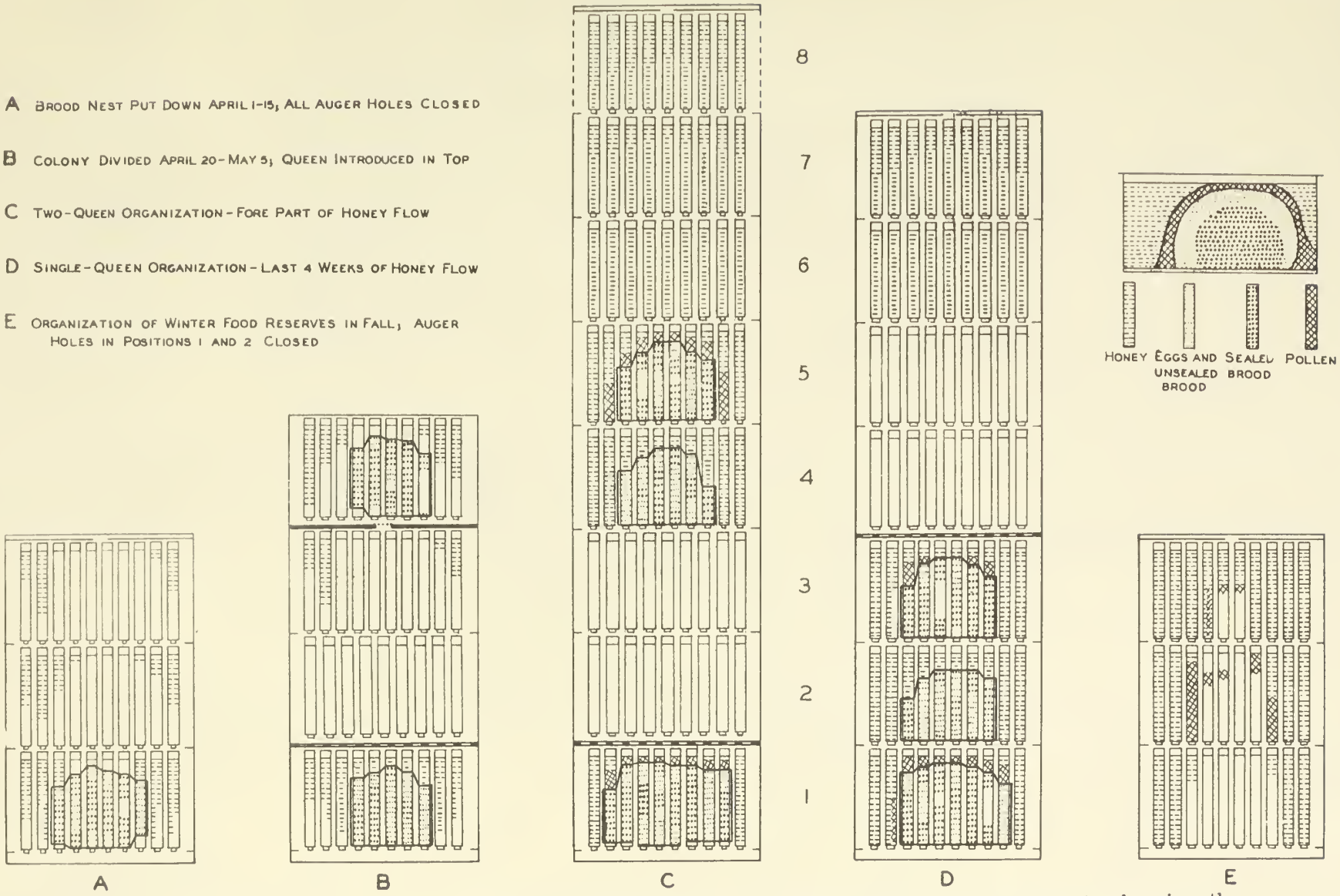

Figure 2.--Diagram of two-queen colony management with 12-frame shallow equipment, showing the organization after manipulation.